Importing and Managing the ALFALFA LEAF-CUTTER BEE

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A BEE TO POLLINATE ALFALFA

The alfalfa leaf-cutter bee is an efficient pollinator of alfalfa that can be managed easily. Because it thrives in man-made nests, you can protect it from bad weather and from enemies, and increase its numbers rapidly. You can incubate it so that it will emerge as an adult when the alfalfa is beginning to bloom and so that it will pollinate the alfalfa in time for seed to mature before frost. Then you can harvest the seed before bad weather is likely to spoil it.

This bee is simpler to manage than the honey bee:

- Incubate it so that it will emerge when the alfalfa is beginning to bloom.
- Provide it with a tunnel to use as a home.
- Set the home beside its food and leaf-cutting source—alfalfa.
- Protect it from its enemies while it is in the field.
- Bring it in when nesting activity is over.
- Protect it from cold weather and enemies by storing it in a cool, mouse-free room.
- At your leisure during the winter, bring in a few nests at a time from the cool room and prepare the bee for the next year.

The main problems now are to import this valuable bee and to build up large numbers of it as quickly as possible for pollinating large acreages of alfalfa.

IMPORTING AND MANAGING THE ALFALFA LEAF-CUTTER BEE

G. A. Hobbs
Research Station, Lethbridge, Alberta

Farmers in Canada now have a good chance to regain domestic and export markets for alfalfa seed. This can be done because we now have a pollinator we can manage fairly easily: the alfalfa leaf-cutter bee.[1] It was accidentally introduced into the United States and has since spread across that country. It has not spread northward into Canada because it cannot survive our winters. Until enough colonies are established in Canada, the bee will have to be imported from regions where it thrives naturally.

This bee is likely to become the most important pollinator of alfalfa in Canada because:

- It thrives in man-made nests, which you can move indoors for the winter to protect the larvae from the cold. In the spring you can incubate them so that the adults will emerge when the alfalfa blooms.
- It is gregarious. Hundreds of females work side by side to fill all the nests with cells. The nests may be soda straws in a carton or tunnels made with grooved boards.
- It trips and cross-pollinates nearly every alfalfa flower that it visits.
- It flies no farther for food than is necessary and can therefore be used to pollinate alfalfa in a particular field.
- You can keep it free from predators, parasites, and disease.

Before this bee became available, certain species of native leaf-cutter and bumble bees were the important pollinators of alfalfa. But the yield of seed was uncertain because the native bees were hard to manage and could not be protected from weather and natural enemies. The native leaf-cutter bees that were valuable pollinators tunneled under clumps of grass on the prairie or into rotting logs in the woodland, but did not nest in man-made tunnels. The important bumble-bee pollinators built nests in man-made hives, but managing them was complicated and time-consuming. Alfalfa seed fields had to be alongside prairie or woodland where the bees nested, and there were seldom enough bees to pollinate a field of 20 acres.

By managing the alfalfa leaf-cutter bee properly, you can produce enough bees to pollinate large acreages of alfalfa. The field may be of any size or shape. You can take the pollinator to the field of alfalfa just as you take honey bees to fields of sweet clover or alsike.

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[1] *Megachile rotundata* Fabricius.

You need not fear the sting of this bee. She will not attempt to sting unless she is squeezed. If you happen to squeeze one and are stung, it is not much worse than being pricked with a needle. The males do not sting.

CAUTION

The alfalfa leaf-cutter bee is a southern bee. In southern Alberta it does not fly until the air temperature is about 70° F. In the Peace River region it seldom flies when the temperature is below 75°, possibly because the humidity is higher there than farther south.

In southern Alberta, where the bee multiplied fivefold in each of the past two years, the average number of flying hours during the pollinating period (June 20 to August 5) was 312. If you know the lowest temperature at which the bee flies in your area, you may work out the number of daylight hours at or above that temperature from information based on records kept at the nearest weather office of the Department of Transport.

LIFE HISTORY

The alfalfa leaf-cutter bee, like all other leaf-cutter bees, is a solitary bee. It does not live in a colony like the honey bee or bumble bees.

When the female emerges from her cocoon, she mates, chooses her nesting site, and then begins to make and provision cells. She obtains no help from the male or from other females.

The female makes cells with cuttings from leaves or petals, as she has no glands to make them of wax. After making the walls out of oblong leaf-cuttings, she fills the cell about two thirds full with a mixture of pollen and honey and then lays an egg on the sticky mass. She caps the cell with circular leaf-cuttings. She builds cells end to end in the tunnel (Figure 1), beginning at the far end and ending near the entrance. She fills the tunnel entrance with closely packed, circular leaf-cuttings; these may help to protect her offspring from enemies and from drying up. When taken from the tunnel, the cylinder of cells seems to be an indivisible unit because the walls of adjoining cells overlap.

The egg hatches in its cell and the larva feeds on the honey–pollen mixture. It sheds its skin several times and is full-grown when all the food is gone. It places its tawny fecal pellets at the head of the cell, beneath the cap. The full-grown larva spins a cocoon in the cell and spends the winter there.

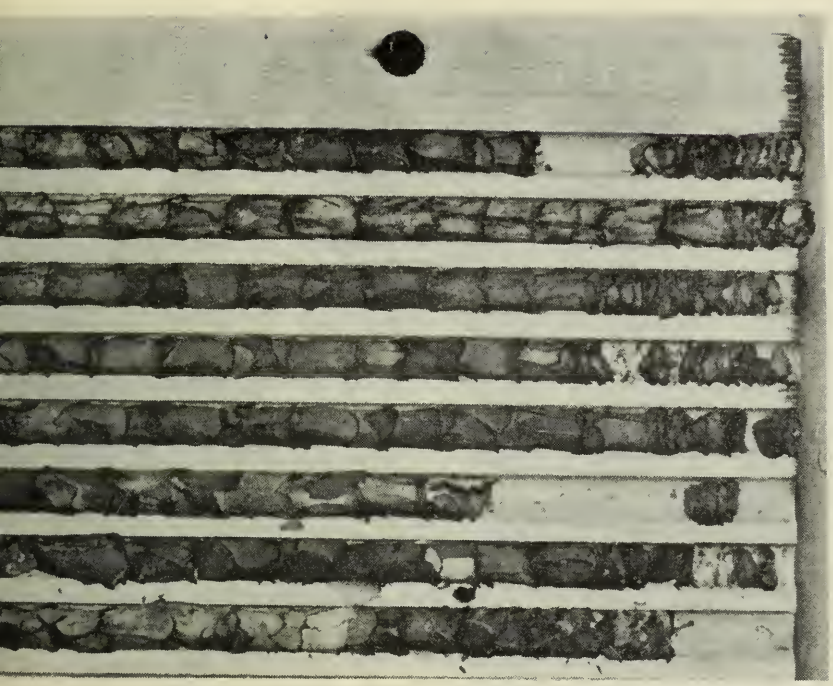

Figure 1 – Nests in tunnels in a grooved board. Note the closely packed leaf-cuttings that seal the tunnels. Cells containing intact cocoons stick to each other more firmly than do other cells; gentle pressure will break them apart.

During the warm weather in the next spring and early summer, it changes to a pupa in the cell and then emerges as an adult.

IMPORTING THE BEES

To import the bees, you must obtain a permit from the Plant Protection Division, Canada Department of Agriculture, Central Experimental Farm, Ottawa. They are inspected at ports of entry by officers of the Plant Protection Division. To facilitate inspection, the bees must be imported in nests that can be opened. The inspectors will refuse nests that they cannot open, such as solid blocks of wood with holes bored in them.

HANDLING ON ARRIVAL

When the bees arrive, you may take them to the Research Station at Lethbridge, Saskatoon, Winnipeg, or Beaverlodge, or to the Entomology Laboratory at Chatham. Officers there will show you how to separate the cells containing live, healthy bees from those containing dead, diseased, and parasitized ones.

After you learn to recognize cells containing healthy bee larvae:

- Remove the cells from the tunnels and separate them. If the cells are in soda straws, you can split the straws quickly with a device (Figure 2) made as follows. Cut a 5- × 2- × 2-inch block of hardwood lengthwise through the middle. Bore a hole at each end, insert bolts, and clamp the two pieces together using washers and wing nuts. Bore a hole $^{9}/_{32}$ inch in diameter through the middle of the block, centering it on the split. Open the block and place two razor blades

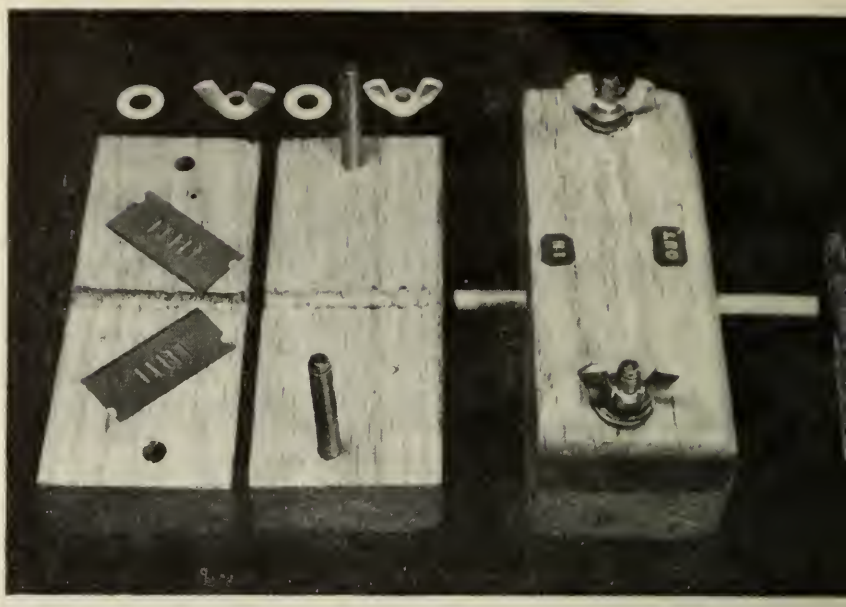

Figure 2 – A tool to split soda straws. Left, how it is made. The straw on the right has been split to expose the row of cells.

so that the corners of the cutting edges stick into the tunnel 1/32 inch. Seat the blades by gouging shallow excavations the size of the blades with a chisel. You now have a tool that makes two cuts 7/32 inch apart—the inside diameter of a soda straw.

- Select the cells that contain intact cocoons (healthy bee larvae). To do this, roll each cell gently between the thumb and forefinger. If the cocoon has not been completed, the cell will collapse or the circular leaf-cuttings forming the cap will pop out.
- Burn the debris, the cells that do not contain completed cocoons, and cells with holes in them.
- Half-fill sealers with cells containing intact cocoons, and put the lids on tight. Store them in a room, such as a root cellar, that you can maintain indefinitely at about 40° F. The dormant larvae need little oxygen; storing them in containers with tight-fitting lids helps to keep them from losing moisture. To make sure that they do not suffocate, remove the lids about once a month and fan fresh air into the containers before resealing them.

MAKING NESTS, SHELTERS, AND INCUBATION TRAYS

Nests

Tunnels 4½ inches long are the most satisfactory. The bees waste more space in longer tunnels. The inside diameter of each tunnel should not be less than 7/32 inch. Three to five times as many males as females are produced in 5/32-inch tunnels as in 7/32-inch ones; in the larger ones, males and females are produced in about equal numbers. Because a female mates only once, it is not economical to have too many males.

It is easy to open nests made of boards with semicircular grooves that fit together to form tubes (Figure 3), and you can use them for many years.

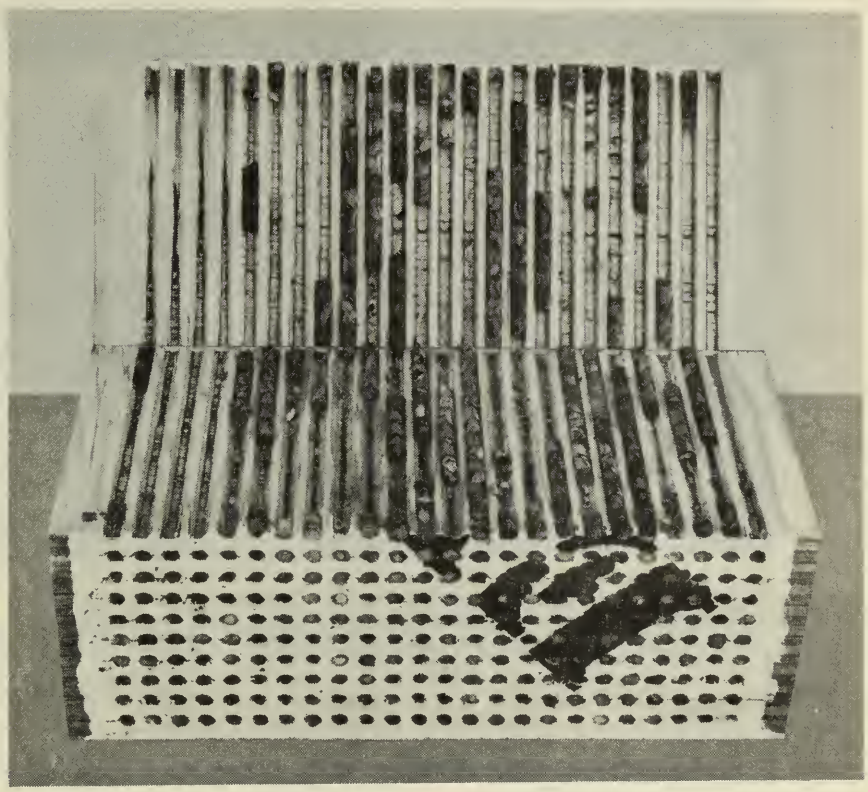

Figure 3 – A layer of nests exposed for inspection by separating the grooved plywood boards. The boards must be separated carefully because cells stick to both sides.

At the Research Station at Lethbridge, three custom-tooled blades with semicircular teeth were made to fit a 12-inch planer. They cut 30 parallel, semicircular grooves ⅛ inch deep, ¼ inch wide, and ⅛ inch apart. Fir plywood ⅜ inch thick was grooved on both sides and cut and stacked so that the grooves formed tubes ¼ inch in diameter and 4½ inches long. The pieces were then stacked vertically in a shelter three feet long, making a 3,000-nest 'hive.' If you use a jointer, you can cut the boards twice the width of the blade and run them through twice on each side. But a jointer is far less efficient than a planer for making grooved boards as you must push the boards over the blades and apply hand pressure. A planer is self-fed and self-pressurized.

Paint the faces of your hives white and stencil your name on them in black. This helps the bees find their own nests and reduces the risk of having your hives stolen. The bees nest first in the tunnels with the dark letters; if the letters are spread evenly across the hive, the bees will make nests evenly across it.

Soda straws with an inside diameter of $^{7}/_{32}$ inch make fairly good nests when cut into 4½-inch lengths. If you cut ¾ inch from the middle of a 9¾-inch straw, you have two 4½-inch tunnels, both with unfrayed entrance ends. However, you have to split the soda straws (Figure 2) to separate the cells with living larvae from those with dead ones at the end of each season. Also, the cells may become moldy because the wax on the straws keeps excess moisture from evaporating.

Figure 4 – A 3,000-nest hive. The nests were made of ⅜-inch fir plywood on a 12-inch planer with 30-tooth blades. Substitute your name for that of Megachile rotundata.

Shelters

Each shelter is open at the front and has a roof with enough overhang to prevent rain from seeping in at the back and from driving in at the front (Figure 4). A 16-inch-wide roof protects a hive 30 nests deep from most storms. An incubation tray fits in a 2½-inch space between the roof and the nests.

- Set the shelters out on posts about four feet high.
- Cultivate a patch of ground directly beneath and in front of each hive. The bees often sun themselves on bare ground to absorb heat.
- Face them east.
- Space them evenly in and around the crop to be pollinated at one 3,000-nest hive per acre. The bees will go no farther for food than is necessary. You will get a more even seed set if you put the hives out in ones or twos than if you concentrate them in a few places. You can set two hives, one below the other, on the same post. It may be several years before you have enough bees to pollinate large acreages. While you are building up your numbers, it is best to house fewer than 1,000 females in a single hive. If you set out too many hives with too few bees in each, the bees will desert some hives and congregate at others.
- Be sure to place the hives as far away from shingled buildings as possible, as the bees may nest in the spaces between the shingles.

Incubation Trays

For incubating the bee larvae for 3,000-nest hives made of ⅜-inch plywood, use trays 35 inches long, 5½ inches wide, and 2 inches deep

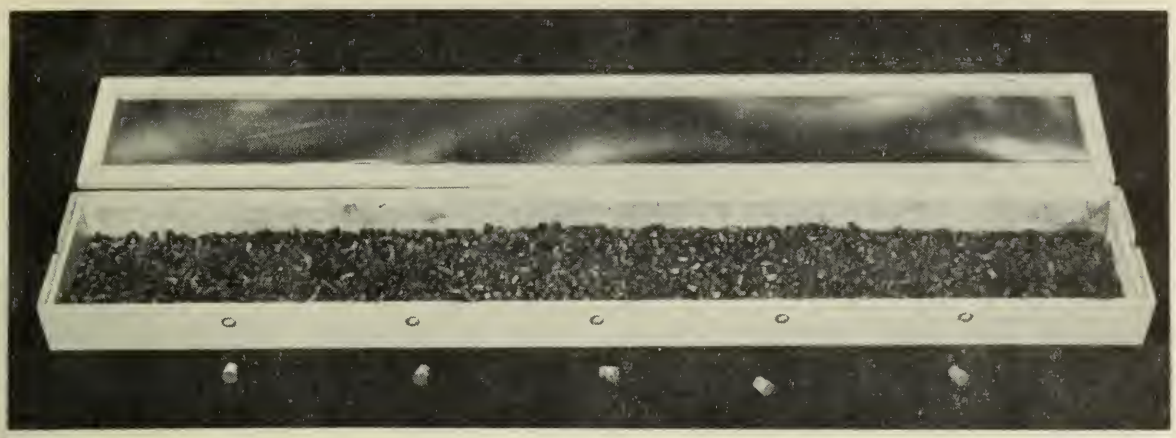

Figure 5 – An incubation tray with a transparent, polyethylene lid and five exit holes, each half an inch in diameter. Note that the holes are bored close to the top; this keeps the cells from spilling out.

(Figure 5). It is better to design your incubator to fit the trays than your trays to fit the incubator. But if you have a narrower incubator, trays 17½ inches long are easier to handle.

Inset tight-fitting lids made of strips of wood and pieces of six-mil polyethylene (Figure 5). The transparent lids allow you to see how many bees have emerged. They also discourage the bees from nesting in the trays by allowing light to get in; some females go back into incubation trays that have light-excluding lids and build cells in the cocoons from which they emerged.

Space five exit holes, each half an inch in diameter, evenly across the front of each tray and put corks in the holes.

ANNUAL ROUTINE

The following is a satisfactory method for managing the bees to increase their numbers rapidly as well as to have them pollinate the alfalfa in time for seed to mature before frost.

Fifteen Days Before the Alfalfa Begins to Bloom

- Remove the jars from the 40° F storage room; spread the cells out in the shallow incubation trays—one cell for every nest in the hive. Because some bees die in the cells and half of those that emerge are males, fewer than half as many females will survive as there are tunnels. Each female can fill two or three tunnels with cells during the nesting season.

- Put the trays of cells in an incubator where you can keep the temperature at about 85° F and the relative humidity at 50-60 percent. An insulated cabinet with thermostatically controlled light bulbs will supply the proper amount of heat; the wattage needed will depend on the size of the cabinet. A shallow pan of water in the bottom of the cabinet near the heat source will maintain the proper humidity. You may have to add water to the pan every two or three days.
- The first insects to emerge may be parasites of closely related native bees. Because the parasites develop much more rapidly than the bees, they emerge much sooner. If you leave them in the incubator, they will usually be dead before the first male bees emerge. If any are still alive when you are ready to take the trays to the field, cool the trays to about 55° F and remove the parasites. The bees cannot walk or fly at this temperature.
- Usually the bees will not begin to emerge until they have incubated for 15 days. But after about 10 days, check the cells regularly for emergence. *Wait until at least 10 percent of the bees have emerged or until the first to emerge have died before you place the trays in the hives in the field.* Almost all of the first 10 percent to emerge will be males. The bees emerge more slowly in the field than in the incubator because the temperature is lower there. If you do not incubate for as long as possible, many of the females may not emerge in time to complete nest-building or to pollinate alfalfa soon enough for the seed to mature before frost. Alfalfa reaches the full-bloom stage soon after the first flowers appear. To make full use of the females, you must have them all out and working by the time the alfalfa is in full bloom.
- Take the trays to the field, place them on the shelves in the hives, and remove the corks. If it is warm, some of the emerged bees leave the trays at once, make short orientation flights, and return to them.

After the Trays are in the Field

- Maintain high humidity in the trays while the rest of the bees are emerging by sprinkling the cells with water about every three days. Do this more often if the weather is hot and dry. Loss of water at this time may cripple the bees or even kill them. All will emerge in about two weeks if the weather remains warm.
- Watch for predation by ants. If ants attack the bees, search for their nests and sprinkle a little 5 percent granular heptachlor on them. Do not spread the heptachlor haphazardly. The bees are very susceptible to most insecticides. As they often sun themselves on the bare patches of ground near the shelters, they will die if you apply insecticide to these areas.

- If you must use an insecticide to control a pest in the alfalfa after the bees have been taken to the field, avoid using a long-lasting insecticide or one that is highly toxic to the bee. The night before you apply it place the hives in a cool, dark room. Leave them there for one to several days, depending on the insecticide used, before replacing them in the field. Be sure to place each in its original position so that you don't confuse the bees.

About Two Months Later

- Remove the hives when almost all of the bees have finished nesting activities. If the weather has been warm and dry for the two weeks before you remove them, place them in a rodent-proof storage room at 40° F.
- If the weather has been cold or if rain dampened the cells in the nests sometime during the previous two weeks, place the hives in a warm, dry room for about two weeks to allow the late larvae to spin cocoons and the cells to dry out. Partly remove the nests from the shelters so that air can circulate around them. Then place the hives in the 40° storage room.
- A few second-generation adults may emerge after the hives are placed in the warm room. Do not worry about losing them. You will be better off with a strain of bees that has only one generation a year.

During the Winter

- Open the nests during slack fall and winter periods and remove the dead, diseased, and parasitized bees and the debris. When grooved boards are full of cells, they stick firmly together. You can separate them with a narrow-bladed putty knife. Loosen the cells by running the knife alongside the cells in the grooves. Dump the cells into a box. If they are damp, let them dry for a day or two before sorting the good from the bad.
- Clean the boards with a stiff bristle brush before putting them back in the hive.
- Store the intact cocoons in the same way as before.
- Prepare enough hives for the next season.

MORE INFORMATION

For more information, consult your agricultural representative or provincial entomologist or write to the nearest station of the Canada Department of Agriculture.

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